SUPPLY SYSTEM FOR SUSPENSION SMELTING FURNACE

This invention relates to a supply system for supplying a suspension smelting furncae with a feed of fine-grained material. Particularly, the invention relates to a method and an installation of feeding metal concentrate containing fine-grained material in a burner of a suspension smelting furnace.

Suspension smelting is a method of producing matte or metal from finely divided metal concentrates, such as copper, nickel or lead concentrates. Typically, a suspension smelting furnace comprises a round vertical reaction shaft for roasting and smelting dried concentrate in suspension; a settling hearth for collecting the molten droplets and separating matte or metal from slag; and an uptake shaft for waste gas and flue dust.

The smelting of the metal concentrate mainly takes place in the vertical reaction shaft. The metal concentrate, oxygen enriched air, and slag-forming agent, i.e. flux, is fed into the reaction shaft via the top part of the shaft.

Various sorts of concentrates and fluxes are mixed and dried in a rotary dryer, a steam drier or a flash dryers. The dried feed is conveyed to the top of the reaction shaft, where the concentrate burner is mounted. Several different types of concentrate burners have been developed to advantageously realize the reactions between the solids and gas in the reaction shaft.

Suspension smelting is a high-capacity method of refining metal concentrates. Production capacity of a modern suspension smelting furnace can be characterized by daily concentrate throughput which is in the range of several thousands (2000 – 5000) of tons of dried concentrate. In running a modern suspension smelting furnace, it is essential that the utilization rate is kept high. The target is to continuously maintain full operation of the furnace for hundreds of hours. Unnecessary down time can be reduced ensuring a continuous and

reliable operation of the concentrate feeding system for the burner of the smelting furnace.

Known approach to solve the problem of providing a continuous and reliable feed of concentrate into the burner is to construct an intermediate storage bin for the concentrate close to the burner on the level of the top of the reaction shaft. Constant feed rate is realized with a feeding control unit arranged between the storage bin and the burner. Dried concentrate may be lifted with a pneumatic conveyor into the storage bin. The charge of the intermediate storage bin should approximately correspond to a three- or four- hours feed of the suspension furnace, i.e. 100 – 600 tons of concentrate. As the height of the furnace exceeds 20 meters, the construction of the intermediate bin becomes heavy and requires high investment.

The present invention solves the problem described above and provides an improved method and installation for providing a burner of a suspension smelting furnace with reliable and continuous concentrate feed. The invention is based on the idea that the heavy construction of concentrate bin is located below the level of the top of the reaction shaft, i.e. close to the ground level. More particularly, the outlet of the concentrate bin is located below the level of the top of the reaction shaft and close to the ground level.

The feed of the burner is fine-grained matter and comprises dried mixture of concentrate and flux and most often also flue dust. In a suspension smelter, it is common practice to recycle flue dust recovered from the exhaust gas. The feed is conveyed on the top level of the reaction shaft with a pneumatic conveyor. The feed rate is controlled with a feed rate controller that is adapted between the storage bin and the pneumatic conveyor.

Remarkable advantages are reached by aid of the present invention. The installation for feeding concentrate mixture into a suspension smelting furnace is simple and the construction becomes lighter. Further, the installation and the

method of the present invention requires lower investments that the constructions presently in use. The installation and the method eliminate incident interruptions of the feed from a concentrate direr.

The installation of the present invention provides a concentrate burner of a suspension smelting furnace with continuous and constant feed of fine-grained matter. The concentrate burner is adapted on top of a reaction shaft of a suspension smelting furnace. The installation of the present invention comprises a bin having an inlet and outlet for the fine-grained matter; a feed control unit for providing the feed of the particulate matter with accurately controlled feed rate; and a pneumatic conveyor adapted to transport the particulate matter up to the top level of the suspension smelting furnace. The outlet of the bin for the fine-grained matter locates essentially at lower level than the top of the reaction shaft. The feed control unit is adapted to receive fine-grained matter from the outlet of the bin and to provide the pneumatic conveyor with the feed of the particulate matter. The pneumatic conveyor is adapted to provide the concentrate burner with a feed rate that equals with the feed rate provided by the feed control unit.

The method of the present invention provides a concentrate burner that is adapted on top of a reaction shaft of a suspension smelting furnace with an uninterrupted and controlled feed of fine-grained matter comprising metal concentrate. The method comprises steps of feeding fine-grained matter in a bin having an outlet at a lower level than the burner; forming and sustaining in the bin a storage of the fine-grained matter corresponding with at least one hours feed of the suspension smelting furnace; feeding fine-grained matter in a feed rate controller unit that provides the pneumatic conveyor with an uninterrupted and controlled feed of the fine-grained matter; and conveying the matter with the pneumatic conveyor in the burner of the suspension smelting furnace.

The fine-grained matter to be fed into the concentrate burner is a mixture of dried metal concentrate and flux. Further, the feed mixture of a suspension furnace may comprise 3 – 15 % of flue dust recovered from the outlet gas after the uptake shaft of the suspension furnace.

According to a preferred embodiment of the present invention the outlet of the concentrate bin is adapted to a loss-in-weight –type feed controller. The operation and principles of a loss-in-weight feeder is described in US 6,446,836. The feed controller is adapted to feed the concentrate into a dilute - phase pneumatic conveyor. The density of the transported fine-grained matter is 10 – 50 kg solid material / 1 kg air and the conveying pressure is normally between 1 and 3 bar. The pneumatic conveyor lifts the particulate matter on top of the reaction shaft and the pneumatic conveyor is adapted to feed the material straight into the concentrate burner. The feed rate into the concentrate burner equals with the feed rate provided by the feed controller.

According to another preferred embodiment of the present invention the outlet of the concentrate bin is adapted to a feed controller of a dense-phase pneumatic conveyor. The pressure in the pneumatic conveyor and in the feed controller unit of the conveyor is around 6 bar. The density of the transported fine-grained matter is 50 – 150 kg solid material / 1 kg air. The pneumatic conveyor is adapted to feed fine-grained matter straight into the concentrate burner.

According to one more embodiment of the present invention the outlet of the concentrate bin is adapted to a loss-in-weight –type feed controller. The feed controller is adapted to feed the concentrate into an air-lift –type pneumatic conveyor. The pressure in the air-lift is around 0.3 bar. The air-lift conveyor is provided with an expansion vessel where most of the compressed air is separated from the solid. The solid is fed via an air-lock feeder in to an air-slide-type conveyor, which is adapted to feed the concentrate into the concentrate

burner. The mass flow provided by the air-slide conveyor is adapted to equal with the feed rate provided by the loss-in-weight controller.

Fig. 1 is a schematic presentation of an installation of a preferred embodiment of the present invention.
Fig. 2 is a schematic presentation of an installation of another preferred embodiment of the present invention.
Fig. 3 is a schematic presentation of an installation of one more embodiment of the present invention.

In the installation of Fig. 1, dried mixture of metal concentrate and fluxing agent is fed via pipe **48** into a bin **10**. The outlet **46** of the bin is adapted to feed the concentrate mixture into a loss-in-weight feed controller **11**. A screw conveyor **14** conveys an accurate mass flow of the concentrate mixture into a pneumatic conveyor **12**, which is a dilute-phase pneumatic conveyor. The pneumatic conveyor **12** lifts the concentrate mixture up to the concentrate burner **13** of the suspension smelting furnace **16**. As shown in Fig. 1, the outlet **46** of the bin **10** is located at essentially lower level than the top of the reaction shaft **15** and the concentrate burner **13**. Flue dust is fed into a bin **17**. The feed ratio of the concentrate mixture and the flue dust has to be carefully controlled. Therefore, the flue dust is fed into a feed rate controller **18** and the controlled mass flow of the flue dust is conveyed via a screw conveyor **19** into the pneumatic conveyor **12**. The flow of the concentrate mixture and the flue dust is continuous and thus ensures unbreakable operation of the suspension smelting furnace **16**.

Fig. 2 shows that dried mixture of metal concentrate and fluxing agent is fed via pipe **47** into a bin **20**. The outlet **45** of the bin is adapted to feed the concentrate mixture into an intermediate pressure chamber **24** for loading the feed controller **21** of the pneumatic conveyor **22**. The pneumatic conveyor **22** is a dense-phase pneumatic conveyor. An accurate mass flow of the concentrate mixture is fed into the pneumatic conveyor **22**. The pneumatic conveyor **22** lifts the concentrate mixture up to the concentrate burner **23** of the suspension

smelting furnace **26**. As shown in Fig. 2, the outlet **45** of the bin **20** is located at essentially lower level than the top of the reaction shaft **25** and the concentrate burner **23**. Flue dust is fed into a bin **27**. The feed ratio of the concentrate mixture and the flue dust is again carefully controlled. Therefore, the flue dust is fed via a loading chamber **29** into a feed rate controller **28** of a pneumatic conveyor **22** and the controlled mass flow of the flue dust is conveyed with the pneumatic conveyor up to the concentrate burner **23**. The flow of the concentrate mixture and the flue dust is continuous and thus ensures unbreakable operation of the suspension smelting furnace **26**.

Fig. 3 shows that dried mixture of metal concentrate and fluxing agent is fed via pipe **43** into a bin **30**. The outlet **44** of the bin is adapted to feed the concentrate mixture into a loss-in-weight feed controller **31** for loading of the pneumatic conveyor **32**. The pneumatic conveyor **32** is an air-lift type conveyor. An accurate mass flow of the concentrate mixture is fed into the pneumatic conveyor **32** via a screw conveyor **34**. The pneumatic conveyor **32** lifts the concentrate mixture up to an expansion vessel **40** where the particulate matter is fed via an air-lock feeder on an air-slide conveyor **42**. The concentrate burner **33** of the suspension smelting furnace **36** is provided with accurately controlled and continuous feed. As shown in Fig. 3, the outlet **44** of the bin **30** is located at essentially lower level than the top of the reaction shaft **35** and the concentrate burner **33**. Flue dust is fed into a bin **37**. The feed ratio of the concentrate mixture and the flue dust is again carefully controlled with the feed rate controllers **31** and **38**. Therefore, the flow of the flue dust is controlled with a loss-in-weight controller **38** and fed via a screw conveyor **39** into the air-lift – type conveyor **32**. The flow of the concentrate mixture and the flue dust is continuous and thus ensures unbreakable operation of the suspension smelting furnace **36**.

The concentrate burners **13, 23, 33** may be of any type of metal concentrate burners. The concentrate burners especially suitable in the installation of the present invention are sleeve type burners and diffuser type burners. The

principle of a sleeve type burner is disclosed in US 6238457, and the principle of a diffuser type burner is disclosed in WO 02/055746.